RELATIVE IMPORTANCE OF RICE IN INDONESIAN ECONOMY

Indonesian Agency for Agricultural Research and Development
Ministry of Agriculture

INTRODUCTION

The Indonesian government through various policies, has paid great attention to fulfil the food need of its steadily rising population. Strong support for research activities has resulted in better information and improved technology for food crop production. These have significantly contributed to the increase of food production, particularly rice crop during the past decades.

Both IRRI and Indonesia have common interests in accelerating rice research systems, rice-based farming systems, and promoting rice technology to increase and sustain rice production. Great challenges of rice production are ahead of us especially in dealing with climate change, diminishing natural resources and more limited available, and increasing population of pests and infection of diseases.

Rice Production

Indonesia - with a population of 237.6 million persons in 2010 - is the world's fourth-most-populous country. A population increase of 1.49%/ann during 2000-2010 required the corresponding increases in food supply. From 2005 to 2013, the average annual rice production was 62.5 million tons from a harvest area of 12.7 million hectares, with an average increase in production of about 3.45%/ann, of which about 1.45%/ann derived from productivity increase (Table 1). Initial target of rice production in 2014 amounted to 76.568 million tons, around 8 percent higher than the rice production in 2013. Target production is apparently not easily achieved due to continued high rate of conversion of irrigated land. Upon review of the prognosis of rice production, the rice production targets agreed to 73 million tonnes in 2014.

Table1. Rice harvest area, productivity, and production, Indonesia: 2005-2013

Year	Harvest area (ha)	Productivity (t/ha)	Production (t)
2005	11,839,060	4.574	54,151,097
2006	11,786,430	4.620	54,454,937
2007	12,147,637	4.705	57,157,435
2008	12,327,425	4.894	60,325,925
2009	12,883,576	4.999	64,398,890
2010	13,253,450	5.015	66,469,394
2011	13,203.643	4.980	65,756,904
2012	13,445,524	5.136	69,056,126
2013	13,769,913	5.146	70,866,571
Growth/year (%)	1,92	1,45	3,45

Source: CBS, 2013

Rice Export-Import Status

In the period of 2005-2013, Indonesia imported rice mainly from Vietnam and Thailand with an average of about 0.9 million tons per year (Table 2). In the same period Indonesia also exported approximately 5,700 tons of rice to several countries such as East Timor, PNG, and South Africa or through Singapore to various countries in Europe and the Middle East. International rice markets were seen as volatile due to the thin nature of the market which was believed to be exacerbated by a low level of substitution between major rice export markets. In other words, this perceived lack of price transmission amongst international rice markets was believed to further thin out an already thin world rice market.

Table 2. Indonesia rice import and export, 2005-2013.

Year	Import (ton)	Export (ton)
2005	189,616	42,286
2006	438,108	959
2007	1,406,847	1.613
2008	289,689	589
2009	250,473	2.455
2010	687,581	345
2011	2,750,476	377
2012	1,810,372	897
2013	472,665	1.944
Average	**921,759**	**5,718**

Source: CBS, 2013

Typical Rice Ecologies

There are four principal types of rice growing; irrigated rice, rainfed lowland rice, upland rainfed rice, and swampy rice. With a land area for rice paddy about 7.9 million hectares, the distribution is presented in Table 3.

Table 3. Indonesia rice is based on agro-ecosystem, 2005

Agro-ecosystem	Area (ha)	%
Large scale irrigation	3,176,456	40.3
Small scale irrigation	1,576,169	20.0
Drought-prone rainfed lowland	2,088,674	26.5
Tidal swamp	657,636	8.3
Others	388,809	4.9
Total	7,885,095	100

MAIN CHALLENGES AND OPPORTUNITIES

Indonesia's population continues to grow over time. When the Dutch government held a 1930 census population it was 60.7 million people nationwide. In 1961, when the first census after Indonesia's independence, the population was of 97.1 million people. In 1971 the population of Indonesia was as much as 119.2 million people, in 2000 there was 205.1 million people, and in 2010 as many as 237.6 million people. In 2050, Indonesia's population is estimated at about 400 million people, with the requirement of rice reaching of 55 million tons, equivalent to 91 million tons of dry unhusked (CBS, 2013).

Rice imports declined from 3.2 million t in 1995 to about 0.69 million t in 2010. With the level of rice self-sufficiency of around 95% (Table 4), there have been concerns, however, that rice imports may surge in the future due to the continuing increase in population. Rice - with its strong influence on economic and political stability - is the dominant agricultural commodity. Efforts to sustain the rice production must thus continue to have high priority.

Table 4. The level of self-sufficiency in rice in Indonesia

Year	Import (M ton)	Self-sufficiency (%)	Level self-sufficiency (%)
1960s	0,72	7.4	92.60
1970s	1,37	9.2	90.80
1980s	0,31	1.3	98.70
1990s	1,79	5.7	94.30
2000s	1,24	3.6	96.40
Average	1.09	5.44	94.56

Source: Rice Almanac, 2013

Despite recent global economic crises, Indonesia has witnessed steady economic growth in recent years. The country rose to lower middle income status in 2009 and had experienced a gradual reduction in overall poverty, from 17 percent in 2004 to 13 percent in early 2010 (IFAD, 2012). Indonesia’s economic growth was expected to reach 6 percent in 2012 and 6.4 percent in 2013. The country’s gross national income per capita had steadily risen from $2,200 in the year 2000 to $4,500 in 2011.

Indonesia became one of the 19 countries considered successful by the Food and Agriculture Organization (FAO) in reducing the number of undernourished population (Table 5). According to FAO, Indonesia managed to reduce the number of undernourished population of approximately 20 % of the total population in the 1990s to 8.6 % in 2012. FAO stated this was an achievement for Indonesia because few countries had managed to achieve and to be considered as one of the objectives set out in the first MDG, two years before the deadline in 2015.

Table 5. MDGs Indonesia (Indicators of poverty and hunger)

No.	Indicator	Baseline	Current	2015 MDGs Target
1	Proportion of population below $1 (PPP) per day (%)	20.60 (1990)	5.90 (2008)	10.30
2	Percentage of people living under the National poverty line (%)	15.10 (1990)	12.49 (2011)	7.55
3	Poverty gap index (%)	2.70 (1990)	2.08 (2011)	Reduce
4	Proportion of own-account and contributing family workers in total employment (%)	71 (1990)	44.24 (2011)	Decrease
5	Prevalence of underweight under-five age (%)	31 (1989)	17.9 (2010)	15.5
6	Prevalence of severe underweight children under-five years of age (%)	7.2 (1989)	4.9 (2010)	3.6
7	Prevalence of moderate underweight Children under-five years of age (%)	23.8 (1989)	13.0 (2010)	11.9
8	Proportion of population below minimum level of dietary energy consumption			
	• 1440 Kcal/capita/day (%)	17 (1990)	14.65 (2011)	8.50
	• 2000 Kcal/capita/day (%)	64.21 (1990)	60.03 (2011)	35.32

Note: Points 1, 3, and 4 had been reached
Source: Bappenas, 2013

National Rice and Challenges Ahead

Food, energy and water problems. Global issus faced by Indonesia in the future are food, energy and water problems due to the persistent problems of agricultural land convertion to non agriculture activities and uncertainty of climate change. In the future, agricultural should be able to produce more food and energy for population, while conserving the environment for a sustainable food production. The role of innovative-adaptive agricultural technology is to became important.

Strategy to develop innovative-adaptive technology consists of (1) exploration, utilization of genetic resource enginering for adaptive superior varieties, (2) optimization and efficiency of land-water resources based on technology of land and water management, fertilization and conservation, and (3) optimalization/efficiency of carbon/biomass/organic waste & zero waste. With the synergy between mitigation, adaptation and productivity and increasing income we could be achieving of national food security and economic growth.

Facing climate change. Indonesia is particularly vulnerable to the vagaries of the El Nino Southern Oscillation (ENSO) phenomenon. In years when the surface-water temperatures rise substantially in the western Pacific Ocean, signaling an El Nino event, rice production suffers a serious shortfall, with most of the effect coming from a reduction in rice area planted. The reduction in area occurs even in systems that are usually irrigated, as lower rainfall leads to a reduced availability of irrigation water.

Three major factors associated with global climate change, the impacts on the agricultural sector are: (1) the changes in rainfall patterns and climatic extremes (floods and droughts), (2) an increase in air temperature, and (3) an increase in sea level. The changes in rainfall patterns, for example, have increased the frequency and intensity of floods and droughts, while rising sea levels have caused the broader land affected by salinity or salinity in coastal areas.

Land conversion. Annual loss of paddy field land due to land conversion to nonagricultural use (commercial, industrial, urban), estimates at about 100,000 ha per year. Nationally, the UNFCCC estimates the occurred wetland conversion of 0.77% per year. Without serious efforts to overcome it, area paddy fields in three provinces in Java, which are currently around 3, 5 million ha, will shrink to 3.0 million ha in 2025. Growth in rice area weakened from 2% per year in 1960-98 to less than a 0.1% increase per year in 1999-2010. Both stagnating growth trends threaten the capacity of local producers to supply enough rice to domestic markets in the coming years.

Inadequate number of highly qualified and educated crop extension. The number of villages in Indonesia was 72.143 while the extension number was as many as 58.123 or 80% for an extension of the village. Therefore, government extension program focuses on: (1) Development of extension institutional, (2) Development of extension man-power, (3) Farmers empowerment, (4) Increasing extension facilities and infrastructure, and (5) Farmers empowerment program through information technology.

Inadequate capital for poor farmers. Farmers income have been eroded due to (a) farmers are price takers and sell most at harvest because of indebt ness, poor storage, lack of market knowledge, (b) rural labor shortage, and (c) little chance to add value. The average farm size is less than 1 ha, with the majority of the farmers cultivating landholdings of 0.1-0.5 ha. Decreasing average farm was due to traditional inheritance practices.

Rice Production Opportunities

New generation of rice scientist. Indonesia has developed a cadre of researchers capable of undertaking rice research and collaborating with colleagues in other countries. At the national level, Indonesian Agency for Agricultural Research and Development (IAARD) has the Indonesian Center for Rice Research (ICRR) which is the main institute conducting biophysical rice research. The Indonesian Center for Agricultural Biotechnology & Genetic Resources (ICABIOGRAD) with the primary duties are on (a) designing research and development program and evaluation in the field of biotechnology and agricultural genetic resources and (b) performing research on cell biotechnology, tissue biotechnology, genetic engineering, and bio prospection of genetic resources. The Indonesian Center of Socio Economic and Agricultural Policy (ICSEAP) has the mandate of which: (a) perform analysis and assessment, in order to produce the information and social sciences agricultural economy and (b) policy analysis, namely activities to process information and knowledge into the formulation of the results of the analysis and consideration of proposed agricultural development policy.

At the provincial level IAARD has the Assessment Institute for Agricultural Technology (AIAT) with the task of accelerating and expanding the dissemination and adoption of agricultural technology-specific location. Together with all concerned institutions IAARD develop more rice varieties that are high-yielding and tolerant to biotic and abiotic conditions. Extension personnel under AIAT are mobilized to promote and disseminate the new varieties to overcome stagnation of rice production.

There were a total of 123 scholars from Indonesia from 2005-2013 consisting of Master and PhD scholar, on the job trainees as well as short term course (Table 6). Through Sustainable Management of Agricultural Research and Technology Dissemination (SMARTD) Project, IAARD also send male and female researchers to different countries in Asia, Australia, Japan and United State.

Table 6. Rice researchers from Indonesia followed IRRI training for degree and non-degree program (2005-2013).

Category	Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Fellow			1	1						2
Intern	1						1			2
MS				1	2		1			4
On-the-Job Trainee		1			1	1	1	7	4	15
PhD		1		2					1	4
Short term Course	23	9	8	13	9	6	4	7	17	96
Grand Total	24	11	9	17	12	7	7	14	22	123

Source: IRRI (2013)

Modern rice varieties. The use of improved modern varieties, fertilizers, and irrigation had made significant contribution to the national rice production. Between 1973 and 2013, Indonesia’s average rice yield increased more than double, from 2.4 t/ha to 5.1 t/ha. In addition to having yield potential, modern varieties enables farmers to quantify the benefits of double transplanting so as to optimize land utilization. In irrigated rice systems, there are triple transplanting of rice-rice-rice, rice-rice-maize/soybean, and other similar high-income of intensive cropping pattern. Another important benefit of modern varieties is the resistance to pest and diseases that allows farmer to reduce pesticide application.

The Ministry of Agriculture had released five new varieties of inbred and hybrid rice in 2013. Four varieties of which were the result of collaborative activities rice breeding of ICRR and IRRI. Four varieties utilizing genetic material had been developed at IRRI, Inpari 32 and Inpari 33 (inbred), HIPA 18 and HIPA 19 (hybrid) (Table 7).

For submergence tolerance rice Swarna-Sub1 (IR05F102) released in 2010 as INPARA 4, IR64-Sub1 (IR07F102) released in 2010 as INPARA 5, and Ciherang-Sub1 (IR09F436) released in 2012 as INPARI 30. The damage can be minimized since these varieties could withstand submergence condition up to 14 days. Efforts are being made to improve nutritive values of rice varieties in providing more micronutrient for rice consumers. These include iron and zinc-rich rice and golden rice that contain high provitamin A. Aside from this current program; some rice production technologies have also been generated.

Table 7. New rice varieties released by the Ministry of Agriculture, Indonesia, 2013.

Variety	Cross	Note
Inpari 31 (B12743-MR-18-2-3-8)	Pepe/BP342B-MR-1-3-KN-1-2-3-6-MR-3-BT-1	Tolerant to BPH biotypes 1, 2, and 3. Tolerant to BLB patotype III
Inpari 32 HDB (BP10620F-BB4-15-BB8)	Ciherang/IRBB64	Moderate tolerant to BPH biotypes 1, 2, and 3. Tolerant to BLB patotype III
Inpari 33 (B11742-RS*2-3-MR-5-5-1-Si-1-3)	BP360E-MR-79-PN-2/IR71218-38-4-3//BP360E-MR-79-PN-2	Tolerant to BPH biotypes 1, 2, and 3. Moderate tolerant to BLB patotype III
HIPA18	IR79156A/IR53942	Moderate tolerant to BPH biotype 1 and not tolerant to BPH biotypes 2 and 3. Moderate tolerant to BLB patotype III
HIPA19	IR79156A/IR65515-47-2-1-1-9	Moderate tolerant to BPH biotypes 1, 2 and 3.

IMPLICATIONS OR STRATEGIES FOR NATIONAL RICE R & D

To address its economic and food security challenges, the government of Indonesia through the Ministry of National Development Planning (BAPPENAS) has formulated a development plan spanning 2005-2025. The overall plan includes 5-year medium-term plans, each with different development priorities. The current medium-term development plan covering 2009-2014 is the second phase and focuses on promoting the quality of human resources and the development of science and technology, and strengthening economic competitiveness with a targeting an average growth for the country of 6.3-6.8% for 2010-2014.

Strategic objectives of Agricultural Department for 2015-2019 are (1) Increasing food security with the provision of basic foodstuffs (rice, corn, soybeans, sugar, meat, and other), (2) Increasing the quality, value added, competitiveness, exports of agricultural products and import substitution, (3) Increased bio-availability of raw materials and bio-energy industry, and (4) Increased provision of agricultural infrastructure

Agricultural Development Strategy for 2015-2019 are (1) Making a production base of food commodities, commodity exports, a provider of bio-materials and bio-energy industry with a regional approach, (2) Improving the quality, added value and competitiveness of agricultural products, (3) Providing basic agricultural infrastructure,

(4) Providing protection and empowerment of farmers, and (5) Improving good governance.

IRRI estimates that Indonesia will require 38% more rice in 25 years, which means that the present average rice yield of 5.1 t/ha (2013) must increase to more than 6 t/ha to fill the gap. Rice production target for the year 2015-2019 are presented in Table 8.

Table 8. Target for rice supply 2015-2019

Item	Production target					Average
	2015	2016	2017	2018	2019	
Production (ton)	74,679,000	76,396,617	78,153,739	79,951,275	81,790,155	78,194,157
Harvest area (ha)	13,999,969	14,279,969	14,565,568	14,856,879	15,154,017	14,571,280
Productivity (t/ha)	5,334	5,350	5,366	5,381	5,397	5,366

Source: Directorate General of Food Crops, 2014

The government sets a production target of 10 million t of rice surplus on 2014 mainly through farmer field school of integrated rice crop management for 4.5 million hectares (Table 9).

Table 9. FFS of Integrated Crop Management in different rice environment, 2013.

Region	Irrigated rice	Hybrid rice	Swampy areas	Lebak areas	Upland rice	Total (ha)
Growth	61,800	-	96,000	26,000	111,100	297,900
Development	272,500	200,000	-	-	117,200	589,700
Consolidation	3,417,000	-	-	-	320,400	3,737,400
Total (ha)	3,751,300	200,000	96,000	26,000	548,700	4,625,000

Indonesia has a long and successful experience in assembling and disseminating rice-technology packages - with technical and economic components. Building on that experience, there is now opportunity to assist farmer groups to combine the best features of the existing rice-production expertise with that of the twelve components of ICM approach to raising rice yield and production. The new technologies include one or several of the components of a recommended ecozone-specific integrated-rice-crop-management (IRCM) package (Table 10).

During 2008 to 2013, the adoption of ICM/Farmer-Field-School (FFS) methodology expanded to more than three million hectares of irrigated lowland rice. Each of the one million hectares or 400,000 ICM/FFS units comprised 25ha of farmers' fields and a one-hectare farmer-managed Field Laboratory. Monitoring (by ICFORD, ICATAD and ICRR) indicated (Table 11) that for some ICM component technologies the Year-2008 diffusion/adoption was relatively low -notably for fertilizer application (SSNM) and for intermittent irrigation. However, encouraging increases (from 2008 to 2012) were seen for basal organic fertilization, seedling age and seedling/hill and transplanting geometry, SSNM, and integrated insect-pest management. On the average the farmer participants of ICM obtained rice yields 6-9% higher and 11-15% more income than non-ICM farmers.

Table 10. Summary of Indonesian integrated rice crop management recommendations.

Management Area	Alternative IRCM Components	Key Check
Pre seeding planning	1. Use appropriate high-yielding cultivar	(1) Use a locally appropriate high-yield cultivar as a recommended variety
	2. Use high vigor seeds	(2) Used certified and high vigour seeds/seedlings through a flotation technique
Crop Establishment	3. Used young seedling 4. Transplanting of 1-3 seedlings $hill^{-1}$	(3) Nursery seeded together
	5. Square (20 x 20 cm to 25 x 25 cm) or paired row (*legowo*) [1)] geometry for transplanting	(4) Achieve sufficient plant population to ensure adequate grain-sink size
Nutrient Management	6. Basal incorporation of organic fertilizer at 2 t ha^{-1} 7. Fertilizer application guided by SSNM	(5) Achieve enough tillers at panicle initiation
Water Management	8. Intermittent irrigation	(6) Avoid excessive water or drought stress
Pest Disease Management	9. Mechanical weeding by rotary weeder 10. Integrated insect-pest management	(7) Ensured no yield loss due to weeds and pests
Harvest Management	11. Threshing by a power thresher	(8) Reaped at the right time
		(9) Threshed at the right time

Table 11. Percent status of adoption ICM component in the Field Laboratory-ICM Indonesia.

No	ICM component technology	Year			Increase 2008-12 (%)
		2008 (n=163)	2009 (n=165)	2012 (n=190)	
1	Use appropriate high-yielding cultivar	98	100	100	2
2	Use high vigor seeds	98	100	100	2
3	Basal incorporation of organic fertilizer	37	45	87	50
4	Used young seedling	52	82	96	44
5	Transplanting of 1-3 seedlings $hill^{-1}$	64	73	97	33
6	Square (20 x 20 cm or paired row (*legowo*)geometry (25x12.5cm)x 50cm) for transplanting	10	38	52	42
7	Fertilizer application guided by SSNM	0	21	39	39
8	Integrated insect-pest management	12	39	44	32
9	Intermittent irrigation	0	7	11	11
10	Mechanical weeding by rotary weeder	30	41	67	37
11	Threshing by a power thresher	76	92	95	19

Indonesia has total rice area of 8.2 million hectares consisting of 4.8 million hectares of irrigated land, around 2 million hectares rainfed rice, 1.0 million hectares upland rice, and 0.6 million hectares flood prone areas. It means around 45% of the area is unfavorable rice environments.

One of the possible solutions to this problem is to enhance rice production in the unfavorable environment where the current yield is only 2 to 3 tons per ha in contrast to the 5 to 6 tons per ha in the irrigated environment. However, most of the unfavorable areas are exposed to various abiotic stresses, which constrain attainable production in the marginal environment.

In most cases, abiotic stresses such as drought, flooding, and insect or pest attack occur due to erratic rainfall and low fertility of highly weathered soil. Erratic rainfall is a regional phenomenon that arises from global atmospheric and oceanographic events. Highly weathered soil is the result of a long process of soil formation under high temperature and humidity with intensive rainfall. Both are impossible to change and thus remain a pressing problem especially for rainfed rice production. Improving this to ensure better rice production in such an ecosystem is a formidable challenge.

Research by Indonesian Center for Rice Research (ICRR) results a series of technology information that later it is reviewed and developed as an Integrated Crop Management (ICM) concept. The Ministry of Agriculture through the Directorate General for Food Crops is implementing the ICM Field School to promote increase the national rice production. However, for unfavorable rice ecosystem or non-irrigated rice, except for the modern varieties, the technology for cultural practices of ICM is not developing as fast as for irrigated ICM.

One of our concerns in maintaining self-sufficiency is how we must increase our productivity level. Keeping that effort in mind, Department of Agriculture formulates some programs that include improving the irrigation system, creating new agricultural lands (especially sub-optimal lands), the utilization of high-yielding new plant varieties, and the implementation of technology for plant cultivation.

To accelerate the adoption of new rice varieties, Indonesian Center for Rice Research together with Assessment Institute for Agricultural Technology at 33 provinces of Indonesia increase the seed production of modern rice varieties for locally specific, especially for unfavorable areas such as submergence, salinity, drought-prone and upland ecosystem.-